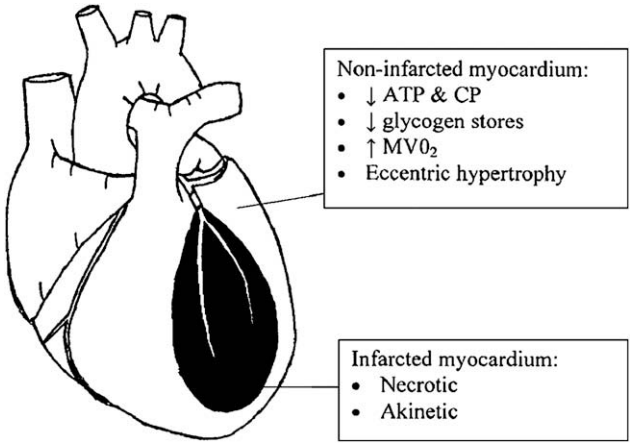

FIGURE 1. Myocardium after coronary artery occlusion. The infarcted myocardium is necrotic and akinetic. The larger noninfarcted myocardium undergoes physiologic and biochemical changes. *ATP,* Adenosine triphosphate; *CP,* creatine phosphate; *MVO_2,* myocardial oxygen consumption.

by 2 to 4 days of preoperative metabolic therapy with oral orotic acid as a means of protecting the recently infarcted heart during emergency cardiac surgery. Orotic acid is a pyrimidine precursor that can augment the rate of synthesis of RNA, proteins, and glycogen. Pretreatment with orotic acid, in animal models, improves the functional recovery of the infarcted heart after cardioplegic arrest (43% recovery of prearrest function in orotic acid–treated groups compared with 18% in untreated groups; $P < .001$).[3]

In conclusion, the results of Miyahara and associates are promising and provide practical evidence for the benefits of avoiding crossclamping of the aorta. These benefits can best be explained by an improved understanding of the changes that occur in the remote, noninfarcted myocardium. We have shown that these changes can be attenuated by preoperative metabolic therapy with orotic acid. We propose that the use of the OPBH technique, combined with metabolic strategies, could result in better recovery in patients undergoing cardiac surgery after MI than with either technique alone and could allow cardiac surgery after recent MI to be performed even more safely and effectively.

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Reply to the Editor:

We appreciate the comments of Varatharajah and Rosenfeldt on our article, ''On-Pump Beating-Heart Coronary Artery Bypass Grafting After Acute Myocardial Infarction Has Lower Mortality and Morbidity.''[1] The comments indicate the importance of preserving the function of noninfarcted myocardium, which is highly susceptible to the effects of ischemia, and represent theoretical grounds for the benefits of avoiding reperfusion injury after crossclamping the aorta during coronary artery bypass grafting (CABG) in acute myocardial infarction (AMI).

We are impressed by the fact that the metabolic[2] and structural[3] changes in the myocardium after infarction were investigated many years ago during the early stages of cardiac surgery.

We have treated another 45 patients with AMI since our report and have applied this technique consistently. The results have been excellent, with an overall hospital mortality of 2.2%. The only patient who died had a left main trunk infarction and required percutaneous cardiopulmonary support preoperatively. We confirmed the reliability of this technique. Technological advances in devices such as a suction stabilizer, apical suction cardiac positioning device, intravascular shunt, and temporary occlusion device enable us to perform on-pump beating-heart surgery reliably and safely.

To save these critically ill patients, in addition to avoiding cardioplegic arrest, we would like to emphasize the need for cardiopulmonary bypass to compensate the residual myocardial function and visceral organ failure.

We know little about orotic acid. On the basis of experimental findings in dogs,[4] it is attractive and may help to improve the results. In our series of patients with AMI, the mean time interval from the onset of AMI to CABG was 18 hours. Therefore, orotic acid can be administered only during the few hours that are available between admission and surgery, allowing one or two doses at most. Further study is required to determine whether preoperative metabolic therapy with oral orotic acid is effective in this clinical setting.

In summary, on-pump beating-heart CABG is the best form of surgical treatment for patients with AMI.

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INTRAOPERATIVE CORONARY ANGIOGRAPHY: WITH OR WITHOUT ISCHEMIA?

To the Editor:

We read with interest the article by Kilian and coworkers[1] entitled ''Intraoperative coronary angiography in the management of patients with acute aortic dissection and endocarditis.'' The authors describe the possibility of performing an intraoperative angiographic assessment of the coronary arteries in patients with potential contraindications to the conventional preoperative cardiac catheterization in the catheterization laboratory. In fact, in patients presenting with acute aortic dissection, the diagnosis is usually accomplished by means of computed tomographic scanning and transesophageal echocardiographic analysis, and the patient is immediately moved to the operating room for emergency surgical intervention. In such a setting, conventional cardiac catheterization is time consuming and could generate a harmful delay to intervention. Furthermore, patients with aortic valve endocarditis with vegetations are at high risk of embolization during cardiac catheterization.

We agree with the authors about the feasibility and efficacy of this diagnostic strategy, and we commonly use intraoperative coronary angiography (ICAN) in the following situations: aortic endocarditis, acute aortic dissections, and mechanical complications of an acute myocardial infarction. The latter, like postinfarction ventricular free wall rupture, could be better managed with an on-pump beating heart operation to reduce the ischemia–reperfusion injury[2] caused by cardioplegic arrest in patients with recent or ongoing acute coronary syndromes. Nevertheless, we are a little concerned with the technique described in Kilian and coworkers' article.[1]

The authors perform ICAN during cardioplegic arrest of the heart; this results in prolonged crossclamp time and, consequently, longer myocardial ischemia. This is particularly true if the coronary lesions are not easily detectable and several different projections are needed. Furthermore, this technique cannot be performed in patients undergoing an on-pump beating heart operation. Thus we strongly believe that ICAN should be carried out through a femoral artery access with the heart beating after aortic crossclamp removal and before weaning from cardiopulmonary bypass (CPB) or decannulation. In particular, in patients undergoing operations on the aortic valve, the ascending aorta, or both, ICAN can be safely performed after that the procedure is completed and the aortic clamp is removed. If coronary lesions are found, off-pump coronary artery bypass or, if that is not possible, on-pump beating heart coronary artery bypass grafting can be performed, thus resulting in less myocardial ischemia, shorter CPB duration, or both. Furthermore, additional information other than the coronary mold could be obtained with the beating heart technique: speed of contrast washout, milking effects, and, most of all, a more physiologic view of the coronary anatomy.

In conclusion, we believe that performing ICAN with the heart beating has several advantages. First, it does not increase crossclamp and CPB times. Second, it can be performed without many interferences, such as sternal retractors and aortic clamps. Third, it can be done during on-pump beating heart operations. Finally, it provides views similar to those obtained with a conventional study that, consequently, are more easily interpretable.

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Reply to the Editor:

We appreciate the response to our article ''Intraoperative Coronary Angiography in the Management of Patients With Acute Aortic Dissection and Endocarditis'' and thank D'Onofrio and colleagues for their interest in the described intraoperative angiographic technique. As mentioned in their Letter to the Editor, the authors discuss the prolongation of myocardial ischemia while performing intraoperative coronary angiography (ICA) during aortic crossclamping (ACC) instead of performing ICA after removal of the aortic clamp via a peripheral artery, as described in their case report[2] of a patient presenting with an ischemic rupture of the left ventricular lateral wall. We agree that ischemia should be reduced as much as possible and that performing ICA during the reperfusion period is a good alternative, but we wanted to avoid this approach for our patients.[1] We intended to intubate the coronary